

Notice of Allowability

Application No.

10/776,364

Examiner

Andrew Lai

Applicant(s)

PARK ET AL.

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to 2/11/2004.
2. ☒ The allowed claim(s) is/are 1-23.
3. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some* c) ☐ None of the:
- ☒ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
- (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
- 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
- (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statements (PTO/SB/08),
Paper No./Mail Date _____
- ☐ Examiner's Comment Regarding Requirement for Deposit
of Biological Material
- ☐ Notice of Informal Patent Application
- ☐ Interview Summary (PTO-413),
Paper No./Mail Date _____
- ☐ Examiner's Amendment/Comment
- ☒ Examiner's Statement of Reasons for Allowance
- ☐ Other _____

REASONS FOR ALLOWANCE

1. The following is an examiner's statement of reasons for allowance:

Claims 1 – 23 are allowed.

The present invention is directed to an apparatus and method for reducing peak-to-average power ratio (PAPR) in an orthogonal frequency division multiplexing (OFDM) system. Each independent claim identifies certain uniquely distinct features as underlined below.

Regarding claim 1, ...

a single IFFT ... for performing an Inverse Fast Fourier Transform process on the plurality of signals of the signal block ...
a shift register for storing the plurality of samples of the conversion sequence symbol generated from the IFFT,
a plurality of multiplier groups ...
a plurality of adder groups ...
wherein the shift register includes a plurality of memories serially connected to each other for storing individual samples and acts as a cyclic shift register for connecting an output terminal of a last memory among the memories to an input terminal of a first memory among the memories, such that a first input sample among the individual samples is applied to the first memory when it is generated from the last memory; and
wherein the plurality of multipliers are each connected to output terminals of the plurality of memories, receive a plurality of mask coefficient groups, each including mask coefficients for generating a plurality of signal sequences ... and multiply output values of the plurality of mask coefficient groups, whenever the individual samples of the shift register are circulated.

Regarding claim 6, ...

performing an IFFT process on the plurality of signals of the signal block ...
storing the plurality of samples of the IFFT-processed conversion sequence symbol in a shift register, wherein the shift register includes a plurality of memories, which are serially connected to each other, for storing individual samples, and acts as a cyclic shift register for connecting an output terminal of a last memory among the plurality of memories such that a first input sample among the plurality of samples is applied to the first memory whenever it is generated from the last memory;
connecting a plurality of multiplier groups ...
receiving in the plurality of multipliers, a plurality of mask coefficient groups, each including mask coefficients, ...

multiplying output values of the plurality of memories by another received mask coefficient group among the received plurality of mask coefficient groups, whenever the plurality of samples of the shift register are circulated.

Regarding claim 11, ...

a single IFFT ... for performing an Inverse Fast Fourier Transform process on the plurality of signals of the signal block ...

a mask operator for receiving a plurality of mask coefficient groups for generating a plurality of signal sequences ..., multiplying the plurality of samples by another received mask coefficient group ... whenever the individual samples of the shift register are circulated, and generating a plurality of masking-processed sequences.

Regarding claim 19, ...

performing an IFFT process on the signals of the signal block ...

receiving a plurality of mask coefficient groups for generating a plurality of signal sequences ..., multiplying the plurality of samples by another received mask coefficient group ... whenever the plurality of samples generated from the IFFT are circulated, and generating a plurality of masking-processed sequences.

One closest prior art of Bauml et al (US 6,125,103), disclosing a "method and device for reducing the crest factor in digital transmission procedures" (col. 1 lines 1-3), teaches, referring to fig. 3, employing multiple IDFTs (same as IFFT) followed by a plurality of multipliers, using m-ary differential phase shift keying technology, that multiply a small number of parameters b_v , with $b_v = \text{const.} \cdot e^{j\Phi_v}$ (masking coefficients, col. 5 lines 38-39) to IDFT transmit sequences $a_\mu^{(v)}$ (plurality of samples of the conversion sequence symbol generated from the IFFT, col. 5 equation (2), which also suggest using adders for adding up output values of the plurality of multipliers), similar to the feature of masking operator (or operation) of present application. Bauml also discloses a selector (or selection) (fig. 3 the "+" block) wherein "a sequence being favorable in view of the peak value of the pertinent transmit signal is selected and

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transmitted” (Abstract line 11-13). Bauml is silent on the key features of *single IFFT* as well as using *cyclic shift registers*.

Another closest prior art of Xiong (US 2003/0227867), teaching a “MASK-OFDM system” (Abstract line 5), discloses a MASK (M-ary Amplitude Shift Keying) operation in an OFDM transmission device (see fig. 5) wherein a plurality of multipliers and adders are used. Xiong also discloses using a *single DCT* (discrete cosine transformation, equivalent to IFFT) (see fig. 6) (also refer to fig. 5 and see “The system accept a plurality of data streams. ... Each data stream is the modulated by using digital communication components like an M-ary ask modulator and multipliers. The modulated signals are then multiplexed through a multiplexer. In one example, the multiplexer may be an adder” recited [0106] lines 2-9). However, Xiong’s system performs DCT **after** the MASK operation.

It would **not** have been obvious to one skilled in the art at the time of the invention to modify Bauml by adding the features of Xiong, or vice versa, because such a modification would have to involve un-suggested and substantial changes and/or alterations of the principles of either Bauml or Xiong, or both.

In addition, Bauml and Xiong, singularly or in combination, also fail to anticipate or render the following underlined features obvious, such as:

[Claims 1 and 6] a plurality of memories serially connected to each other ... such that a first input sample among the individual samples is applied to the first memory when it is generated from the last memory; and multiply output values of the plurality of mask coefficient groups, whenever the individual samples of the shift register are circulated.

[Claims 10 and 19] a single IFFT ... receiving a plurality of mask coefficient groups for generating a plurality of signal sequences and multiplying the plurality of samples by another received mask coefficient group ... whenever the individual samples of the shift register are circulated, and generating a plurality of masking-processed sequences.

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because both system are silent on a cyclic shift register that would circulate the IFFT generated conversion sequence samples for a number of times or rounds and multiply, in each time or round, another masking coefficient group (having a different set of masking coefficients) to said IFFT generated conversion sequence samples.

Therefore, said independent claims are allowed for the reasons cited above, and so are the dependent claims therefrom.

2. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

3. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

US 2003/0067866 discloses a method and apparatus for reducing peak power in partial transmit sequence OFDM.

US 2003/0202460 provides transmitting and receiving side information in an OFDM system.

US 2002/0150036 teaches peak-to-average power reduction in an OFDM system.

US 2001/0022777 provides a system and method for reducing peak to average power ratio (PAR) in single and multi-carrier transmitters.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Andrew Lai whose telephone number is 571-272-9741. The examiner can normally be reached on M-F 7:30-5:00 EST, Off alternative Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kwang Yao can be reached on 571-272-3182. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

KWANG BIN YAO
SUPERVISORY PATENT EXAMINER

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A handwritten signature in black ink, appearing to read 'Kwang Bin Yao', is written over the printed name and title.